Light-dependence of mitochondrial activity and pupillary pigment migration in blowfly photoreceptors

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Light-dependence of mitochondrial activity and pupillary pigment migration in blowfly photoreceptors

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In vivo microspectrophotometry of the white-eyed blowfly *Calliphora erythrocephala*, mutant chalky, reveals a prominent fluorescence of the pigments of the mitochondrial respiratory chain. Illumination of a dark-adapted chalky eye induces a transient increase in the blue-induced green emission from the mitochondrial flavoproteins (Chance & Williams, 1956) which is followed, after approximately 1 s, by an emission decrease, lasting several seconds (Stavenga & Tinbergen, 1983). The action spectrum of this fluorescence change peaks at 490 nm and coincides with that of the receptor potential, suggesting a prime involvement of the phototransduction chain in mitochondrial activity.

In the wild-type blowfly, illumination of the dark-adapted eye induces migration of pigment granules within the photoreceptor towards the organelle containing visual pigment molecules, the rhabdomere. These pigment granules attenuate the rhabdomeric light flux and act as a pupil with a time constant of about 1 s. In this study we correlate the pupil effect with mitochondrial activation. We measured the pupil effect microspectrophotometrically via the blue-induced red fluorescence of the visual pigment metaxanthopsin (Stavenga, 1983; Stavenga, Franceschini & Kirschfeld, 1984). The intensity range of the pupil response coincides with that of mitochondrial activation, as determined in the chalky mutant.

The pupil response is driven by a phototransduction-linked process, probably a light-induced increase in cytoplasmic calcium concentration (Kirschfeld & Vogt, 1981; Howard, 1984). Since cytoplasmic calcium can also control mitochondrial respiration (cf. Tsacopoulos, Orkand, Coles, Levy & Poitry, 1983), we suggest that the mitochondrial and pupillary systems are driven by a common input. The light-induced shift of the mitochondrial respiratory pigments towards the oxidized state indicates a transient increase in demand for metabolic energy and this, like the pupil response, may play an important role in light-adapting the photoreceptor.

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